

# What is the relationship between the intake of animal protein products and cardiovascular disease?

## Conclusion

Limited evidence from prospective cohort studies show inconsistent relationships between intake of animal protein products and cardiovascular disease (CVD), with somewhat more positive evidence for processed meats and coronary heart disease (CHD).

## Grade: Limited

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, [click here](#).

## Evidence Summary Overview

The evidence review for this question included seven articles (Djousse, 2008; Halton, 2006; Keleman, 2005; Nakamura, 2004; Nakamura, 2006; Qureshi, 2007; Sinha, 2009), which represented prospective cohorts from the US and Japan published since 2000.

Regarding the relationship between the intake of total animal protein and coronary heart disease (CHD), no relationship was observed in the Nurses' Health Study (Halton, 2006) or Iowa Women's Health Study (Keleman, 2005). However, a positive association between red meat and processed meat and cardiovascular disease (CVD) mortality was observed in the National Institutes of Health-American Association for Retired Persons (NIH-AARP) Diet and Health Study (Sinha, 2009), and substituting red or processed meat (combined) for carbohydrate-dense foods was positively associated with CHD mortality in the Iowa Women's Health Study (Keleman, 2005).

Studies found no association between egg intake and CVD (Djousse, 2008; Nakamura, 2006; Nakamura, 2004; Qureshi, 2007). Thus, limited information is available on this relationship and risk may depend on type of meat or meat products consumed and the type of CVD.

## Evidence summary paragraphs:

**Sinha et al, 2009** (positive quality) examined the relations of red, white and processed meat intakes to risk for total and cause-specific mortality among 545,653 adults (59% men; age 50 to 71 years) in the NIH-AARP Diet and Health Study (US). Deaths were determined by linkage to the Social Security Administration Death Master File and cause of death was determined by follow-up searches of the National Death Index. Meat intake was estimated from a 124-item food frequency questionnaire (FFQ) at baseline. Red meat included all types of beef and pork and included bacon, beef, cold cuts, ham, hamburger, hot dogs, liver, pork, sausage, steak and meats in foods such as pizza and chili. White meat included chicken, turkey and fish and included poultry, cold cuts, chicken mixtures, canned tuna and low-fat sausages and low-fat hot dogs made from poultry. Processed meat included bacon, red meat sausage, poultry sausage, luncheon meats (red and white meat), cold cuts (red and white meat), ham, regular hot dogs and low-fat hot dogs made from poultry. The components constituting red or white and processed meats can overlap because both

can include meats such as bacon, sausage, and ham, while processed meat can also include smoked turkey and chicken. However, these meat groups are not used in the same models; thus, they are not duplicated in any one analysis. During 10 years of follow-up, there were 47,976 male deaths and 23,276 female deaths of all causes. There was an increased risk of CVD mortality in both men (HR=1.27; 95% CI: 1.20, 1.35; P for trend<0.001) and women (HR=1.50; 95% CI: 1.37, 1.65; P for trend<0.001) in the highest compared with the lowest quintile of red meat intake in the fully adjusted model. There was an increased risk of CVD mortality in both men (HR=1.09; 95% CI: 1.03, 1.15; P for trend<0.001) and women (HR=1.38; 95% CI: 1.26, 1.51; P for trend<0.001) in the highest compared with the lowest quintile of processed meat intake. There was a small increase in risk for CVD mortality in men (HR=1.05; 95% CI: 1.00, 1.11; P for trend=0.009) but not women (HR=1.04; 95% CI: 0.96, 1.14; P for trend=0.19) with higher intake of white meat. For CVD mortality, there was an 11% decrease in men and a 21% decrease in women if red meat consumption was decreased to the amount consumed by individuals in the first quintile. The median red meat consumption based on men and women in the first quintile was 9.8 g per 1,000kcal per day compared with 62.5g per 1,000kcal per day in the fifth quintile. For women eating processed meat at the first quintile level, the decrease in CVD mortality was approximately 20%. The median processed meat consumption based on men and women in the first quintile was 1.6g per 1,000kcal per day compared with 22.6g per 1,000kcal per day in the fifth quintile. The authors concluded that red and processed meat intakes were associated with modest increases in CVD mortality.

**Halton et al, 2006** (positive quality) examined the association between the low-carbohydrate (CHO) diet score and risk of CHD in 82,802 women (age 30 to 55 years) from the Nurses' Health Study cohort in the US. Secondary analyses examined the association between animal protein intake and CHD risk. Non-fatal MI was self-reported with follow-up confirmation, and fatal coronary events were identified from state vital records and National Death Index or reported by next of kin or the US Postal Service. Diet was assessed using a semi-quantitative food frequency questionnaire (FFQ) in 1980, 1984, 1986, 1990, 1994 and 1998. During 20 years of follow-up, 1,994 cases of CHD were identified. Animal protein was not significantly associated with the risk of CHD in multivariate analyses (RR between extreme deciles=1.13; 95% CI: 0.91, 1.41; P for trend=0.65).

**Keleman et al, 2005** (neutral quality) investigated the associations of different protein sources with chronic disease mortality in 29,017 postmenopausal women (age 55 to 69 years) in the Iowa Women's Health Study (United States). Mortality was ascertained through linkage with the National Death Index. Diet over the previous year was assessed with a semi-quantitative FFQ at baseline. During 15 years of follow-up, 739 CHD deaths were identified. There was no significant association for CHD mortality from substituting an isoenergetic quantity of animal protein (protein from meat, poultry, dairy, fish and eggs) for the same amount of energy from CHO (P for trend=0.29). When substituting vegetable protein for animal protein while simultaneously controlling for CHO, there was a 30% decreased risk of CHD mortality among women in the highest compared with lowest category of vegetable-for-animal protein intake (risk ratio between extreme quintiles=0.70; 95% CI: 0.51, 0.98; P for trend=0.02). A daily substitution of 0.9 servings of red or processed meat per 1,000kcal in place of a similar number of servings of CHO-dense foods was associated with a 44% increased risk of CHD mortality (risk ratio between extreme quintiles=1.44; 95% CI: 1.06, 1.94; P for trend=0.02). No significant (NS) association was found for poultry or eggs. The authors concluded that long-term adherence to high-protein diets, without discrimination toward protein source, may have potentially adverse health consequences.


**Djoussé et al, 2008** (positive quality) examined the association between egg consumption and the risk of CVD and mortality among 21,327 males (age 53.7±9.5 years) from the Physicians' Health Study I in the US. Myocardial infarction (MI) and stroke were self-reported with follow-up confirmation. Egg consumption was assessed using an abbreviated semi-quantitative FFQ in which




participants were asked to report how often they had eaten eggs (one) during the past year: Rarely or never, one to three times per month, once per week, two to four times per week, five to six times per week, daily and two or more times per day. After an average follow-up of 20 years, a total of 1,550 new MI and 1,342 incident strokes were observed. Egg consumption was not significantly associated with incident MI, total stroke or types of stroke in multivariable Cox regression.


**Nakamura et al, 2006** (neutral quality) examined the association between egg consumption and total cholesterol concentration and CHD incidence in 90,735 adults (52% female; age 40 to 69 years) from the Japan Public Health Center-based prospective study. Incident CHD (non-fatal MI and CHD death) was determined by review of medical records. Two waves of the cohort were included in the analyses. In cohort I, participants self-reported egg consumption as less than one day per week, one to two days per week, three to four days per week and almost every day. In cohort II, participants were also given the option of never consuming eggs. During the mean follow-up of 10.2 years, there were 462 incident cases of CHD (120 fatal, 342 non-fatal). There was no significant association between egg consumption and CHD incidence. The authors concluded that eating eggs more frequently, up to almost daily, was not associated with any consistent adverse effect on CHD incidence.


**Nakamura et al, 2004** (neutral quality) examined the relations of egg consumption to serum cholesterol and cause-specific and all-cause mortality among 9,263 adults (56% female; age  $\geq 30$  years) in the National Integrated Project for Prospective Observation of Non-communicable Disease and Its Trends in the Aged, 1980 (NIPPON DATA80) in Japan. Cause of death (stroke, ischemic heart disease [IHD]) was confirmed by computer matching of data from the National Vital Statistics. Egg consumption was queried using a self-administered question with the options of: At least two per day, approximately one per day, approximately one to two per day, approximately one to two per week and seldom. During 14 years of follow-up, 219 stroke and 80 IHD deaths were identified. In women, unadjusted IHD mortality differed significantly between egg consumption groups. However, these differences were no longer present in multivariate analyses. The multivariate-adjusted relative risk of deaths from stroke and IHD did not differ significantly between the egg consumption categories among women or men. The authors concluded that, among women, there were tendencies for lower mortality due to stroke and IHD in the one to two eggs per week group than in the one egg per day group, but no associations were noted in men.

**Qureshi et al, 2007** (positive quality) examined the association between egg consumption and risk of CVD and mortality in a 9,734 adults (age 25 to 74 years) from the National Health and Nutrition Examination Survey Epidemiologic Follow-up Study (NHEFS). Risk of CVD was determined by assessing incident stroke and CHD at follow-up during in-person interview, collection of hospital records and review of death certificates. Egg intake at baseline was assessed using a detailed questionnaire that included questions about egg consumption in the form of fried, boiled, poached, deviled or egg salad. Eggs in cooked or baked dishes were not included. Egg intake was divided into three groups: No or less than one egg per week, one to six eggs per week and more than six eggs per week. During  $15.9 \pm 5.6$  years of follow-up, 655 strokes and 1,584 MI were observed. A univariate analysis demonstrated a trend for increased rates of coronary artery disease (CAD) with intake of greater than six eggs per week. However, in multivariate analysis, there was no relationship with consumption of greater than six eggs per week and risk of stroke or ischemic stroke. Similarly, compared with persons without any egg intake or less than one egg per week, there was no significant difference in RR for persons with intake of greater than six eggs per week for risk of MI. The authors concluded that consumption of greater than six eggs per week or one egg or greater per day did not increase the risk of CAD, ischemic stroke or all strokes in a cohort representative of the US population.

 [View table in new window](#)

Author, Year, Study Design, Class, Rating	Name of Study/Location	Total Meat Association (Pos, Neg, None)	Red Meat Association (Pos, Neg, None)	Processed Meat Association (Pos, Neg, None)	Poultry Association (Pos, Neg, None)
Djousse et al 2008  Study Design: Prospective Cohort Study  Class: B  Rating: 	Physicians' Health Study.  Location: US.	Not examined.	Not examined.	Not examined.	Eggs: Ø MI, stroke or type of stroke.
Halton et al 2006  Study Design: Prospective Cohort Study  Class: B  Rating: 	Nurses' Health Study.  Location: US.	Animal protein: Ø CHD (non-fatal MI and fatal coronary events).	Not examined.	Not examined.	Not examined.
Kelemen et al 2005  Study Design: Prospective cohort study  Class: B  Rating: 	Iowa Women's Health Study.  Location: US.	Substituting animal protein for CHO: Ø CHD mortality.	Substituting red or processed meat (combined) for CHO-dense food: (+) CHD mortality.	Substituting red or processed meat (combined) for CHO-dense food: (+) CHD mortality.	Substituting poultry for CHO-dense foods: Ø CHD mortality.  Substituting eggs for CHO-dense foods: Ø CHD mortality.

<p>Nakamura et al 2006</p> <p>Study Design: Prospective Cohort Study</p> <p>Class: B</p> <p>Rating: </p>	<p>Japan Public Health Center-based prospective study.</p> <p>Location: Japan.</p>	Not examined.	Not examined.	Not examined.	Eggs: Ø incident CHD (non-fatal MI and CHD death).
<p>Nakamura, Okamura et al 2004</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	<p>National Integrated Project for Prospective Observation of Non-communicable Disease and Its Trends in the Aged, 1980 (NIPPON DATA80).</p> <p>Location: Japan.</p>	Not examined.	Not examined.	Not examined.	Eggs: Ø stroke or IHD in men or women.
<p>Qureshi AI, Suri FK et al, 2007</p> <p>Study Design: Prospective cohort study</p> <p>Class: B</p> <p>Rating: </p>	<p>National Health and Nutrition Examination Survey Epidemiologic Follow-up Study (NHEFS).</p> <p>Location: US.</p>	Not examined.	Not examined.	Not examined.	Eggs: Ø MI, stroke, or ischemic stroke.
<p>Sinha R, Cross AJ et al, 2009</p> <p>Study Design: Prospective cohort study</p>	<p>NIH-AARP Diet and Health Study.</p> <p>Location: US.</p>	Not examined.	Red meat: (+) CVD mortality in men and women.	Processed meat: (+) CVD mortality in men and women.	White meat: (+) CVD mortality in men only.


Class: B					
Rating: 					


## Research Design and Implementation Rating Summary


For a summary of the Research Design and Implementation Rating results, [click here](#).


### Worksheets


 [Djoussé L, Gaziano JM. Egg consumption in relation to cardiovascular disease and mortality: the Physicians' Health Study. \*Am J Clin Nutr\*. 2008 Apr;87\(4\):964-9.](#)

 [Halton TL, Willett WC, Liu S, Manson JE, Albert CM, Rexrode K, Hu FB. Low-carbohydrate-diet score and the risk of coronary heart disease in women. \*N Engl J Med\*. 2006 Nov 9;355\(19\):1991-2002.](#)

 [Kelemen LE, Kushi LH, Jacobs DR Jr, Cerhan JR. Associations of dietary protein with disease and mortality in a prospective study of postmenopausal women. \*Am J Epidemiol\*. 2005;161\(3\):239-249.](#)

 [Nakamura Y, Iso H, Kita Y, Ueshima H, Okada K, Konishi M, Inoue M, Tsugane S. Egg consumption, serum total cholesterol concentrations and coronary heart disease incidence: Japan Public Health Center-based prospective study. \*Br J Nutr\*. 2006 Nov;96\(5\):921-8.](#)

 [Nakamura Y, Okamura T, Tamaki S, Kadowaki T, Hayakawa T, Kita Y, Okayama A, Ueshima H; NIPPON DATA80 Research Group. Egg consumption, serum cholesterol, and cause-specific and all-cause mortality: the National Integrated Project for Prospective Observation of Non-communicable Disease and Its Trends in the Aged, 1980 \(NIPPON DATA80\). \*Am J Clin Nutr\*. 2004;80\(1\):58-63.](#)

 [Qureshi AI, Suri FK, Ahmed S, Nasar A, Divani AA, Kirmani JF. Regular egg consumption does not increase the risk of stroke and cardiovascular diseases. \*Med Sci Monit\*. 2007 Jan; 13 \(1\): CR1-8. Epub 2006 Dec 18.](#)

 [Sinha R, Cross AJ, Graubard BI, Leitzmann MF, Schatzkin A. Meat intake and mortality: a prospective study of over half a million people. \*Arch Intern Med\*. 2009 Mar 23; 169\(6\): 562-571.](#)

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